WRC-CANR-DF-DN
and
WRC-CANR-DF-SM
Series 4
CAN-Bus Fiber Optic Bus Extender
User's Manual

Western Reserve Controls, Inc.

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Document PUB 14.2
Rev 4.01
April 2011

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1. Overview

The WRC-CANR-DF Fiber Optic CAN Bus Extender converts a copper cable medium CAN-Bus network to a fiber optic medium. The WRC-CANR-DF-DN uses multimode fiber obtic cable, while the WRC-CANR-DF-SM uses singlemode fiber optic cable. Both are always used in pairs and inserts a length of fiber media into the copper CAN Bus network. The primary purposes of this type of configuration is to extend the maximum length defined for one continuous network cable bus up to 2.2km (for multimode with WRC-CANR-DF-DN) or 12km (for singlemode with WRC-CANR-DF-SM) and to provide network protection from external, high-energy electrical interference, such as lightning storms, arc welders, etc. They can be connected in a bus trunk line or drop line.

A WRC-CANR can be used for quite a number of helpful purposes, including

- To provide an electrically-isolated fiber transmission segment to your CAN bus for more secure network in high-energy environmental conditions
- to extend the network beyond its absolute maximum at the slowest speed
- to implement a longer network for a given baud rate (e.g., pushing a 500K baud network beyond 100 m for DeviceNet)
- to provide higher speed baud rates for a given network length
- to extend the length of the drop cable (e.g., longer drops than 6 m for DeviceNet)
- to provide 2600V electrical isolation between the 2 sub-nets
- to create a unique network topology instead of a conventional bus structure, such as a star configuration

The Extenders are transparent to the other nodes on the bus. They receive and actively re-transmit (store-and-forward) each message received at either side of the network without interpreting the message or acting upon it. The Fiber Extenders perform all appropriate CAN Bus arbitration on the copper bus as it re-transmits the message.

The WRC-CANR-DF-DN and WRC-CANR-DF-SM are members of WRC's family of products that extend the system communications lengths for DeviceNet, CANopen, SDS (Smart Distributed System), J1939 and other CAN, V2.0, Part A or Part B, serial bus systems. By allowing the user to extend the bus length for any given speed, they assist the user in cost-effectively implementing I/O or other nodes on these buses at remote locations that would be more difficult or more expensive to do otherwise.

The unit derives its power through the copper network connector on Side A.

1.1. Series 4 Specific Features

The Series 4 CANR provides enhancements over previous versions. Enhancements include:

* New Single Mode Fiber Cable Option is now available with Series 4 WRC-CANR-DF-SM.
* New Switch settings allow selection for CANopen speeds up to 1 M Baud in addition to the standard DeviceNet Baudrates
* Increased message internal buffers – Automatic Memory Technology (AMT) operation
* Shorter latency time compared to CANR series 3
* Improved Reverse voltage protection and Can data lines noise immunity

* Up to 2.2 km fiber lengths
* CAN 2A and 2B, and remote frame, support
* Autobaud operation for DeviceNet baud rates
* Either unit in a pair can Autobaud from the other units defined baud rate
* Jumper-selectable terminating resistor on-board the CANR
* Eliminates the distinction between WRC's earlier version Type 1 and Type 2 CANR's

1.2. Features

The WRC-CANR-DF-DN and WRC-CANR-DF-SM have the following features:

* Extends CAN-Bus cable lengths - trunk line or drop lines
* Expands the usable applications for CAN-Bus systems
* Allows operation at higher speeds for specific distances
* Provides superior electrical interference protection to copper cables
* Operates at 9.6K, 10K, 20K, 40K, 50K, 100K 125K, 250K, 500K, 800K and 1M baud
* Switch-selectable Autobaud or fixed baud rate operation
* Automatic speed selection - no configuration required
* Isolates the two sections of the copper bus
* Transparent to the Master and Slave devices on the bus
* No address selection needed
* No configuration parameters
* DeviceNet; SDS; CANopen; J1939; CAN, V2.0, Part A and Part B compatible
* Powered from the 24Vdc supplied by bus network or the user
* Sealed NEMA-4X enclosure
* Standard round, mini-style connector with male pins for copper cable
* *For WRC-CANR-DF-DN*: Standard Fiber Optic ST female connector, 62.5/125µm technology
* *For WRC-CANR-DF-SM*: Standard Fiber Optic ST female connector, 9/125µm technology
* Standard CAN chips manage bus error detection
* Standard CAN chips handle message bus contention
* Less than 100 µsec latency
* Jumper-selectable termination built in on cable side
* 4 bi-color (red/green) status LEDs
* 2 green fiber transmit and receive LEDs

1.3. Basic Operation

Two CANR-DF units are included in an order and both are required for each application – both units are identical. It does not matter which is placed in which position with respect to the network topology or other devices on the network.

There are two bus connections for each CANR-DF, referred to as the Copper Cable Network Side (Side A) and Fiber Cable Network Side (Side B). The CAN Bus copper cable is connected to side A of the CANR-DF receives its power from side A.

Figure 1-1 shows a typical application.

Whenever a message is transmitted on the Bus to which CANR-DF is connected, CANR-DF receives the message on the side where it was initiated and performs a store-and-forward of the message to the other side. This action is performed in each direction and is performed for any valid CAN message independent of who generated it or to whom it is intended.

There is approximately a 75µsec propagation delay of the message through the CANR-DF.

The CANR-DF is not addressed as a specific device on the Bus and cannot be interrogated by other nodes. It is transparent to all other nodes on the bus.

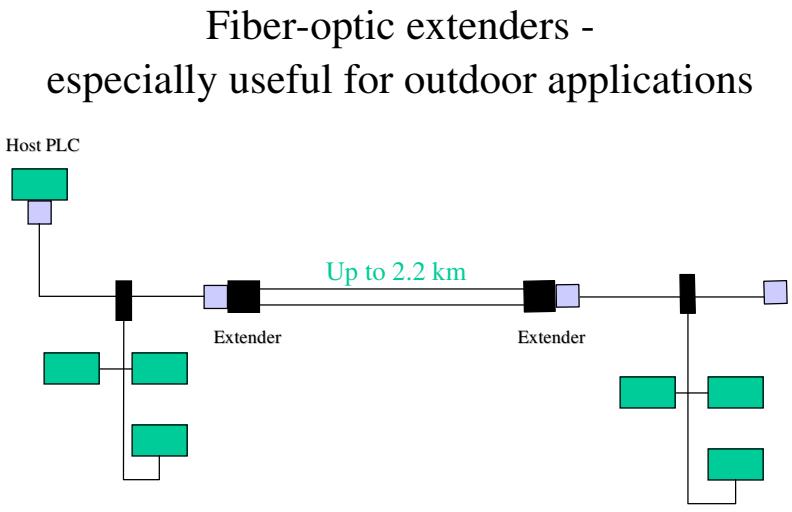


Figure 1-1 Typical fiber optic bus extension application

1.4. Reference Documents

The following documents are referenced in this User's Manual

* ODVA DeviceNet Specification Volume I, Release 2.0 or CIP specification Volume 3
* Honeywell Micro Switch Specification GS 052 104, "SDS Smart Distributed System Physical Layer Specification", release date 12/8/1994

2. Quick Start

To quickly and easily install your CAN-Bus Fiber Optic Extenders in your DeviceNet system, follow the instructions below. For more details, see Section 4.

1. These units are used in pairs. You need **two (2) CANR-DF** units and **two (2) 62.5/125, multi-mode fiber cable lengths**, terminated with **ST male connectors**.
2. Set the baudrate of each CANR-DF to **Autobaud** by setting the switches on the 8-position switch block **SW1** to **all OPEN**.
3. Using on-board jumper W1, terminate CAN-Bus network, as appropriate. (This is especially critical at the higher baud rates.)
    - **For trunk lines, install W1.**
    - **For drop lines, remove W1.**
4. **Connect the fiber cables** to the CANR of one unit. Make sure they are clearly marked on both ends to differentiate between the two lines.
5. Make sure that there is power on the CAN-Bus Network and **plug the Network cable with a 5-pin round female MINI connector** into the CAN-Bus Extender.
6. The CANR-DF Extender will undergo its initialization sequence, flashing the LEDs. After approximately 5 seconds, the Module Status LED (labeled "MS") will go on solid green and network LEDs (labeled "NSA" and "NSB") will flash green. The DGN led might stay solid red until the fiber cables are connected to the other CANR and both CANRs are powered up.
7. **Repeat steps 2-6 above for the second CANR-DF**.

    Note: Be sure to connect the fiber from the TX port on one device to the RX port on the other.
8. Connect the desired network devices to both sides of the copper CAN bus.
9. Both Network A and B Status LEDs (NSA and NSB) will go on solid on each unit once a valid CAN message is received into either side of the Extender and the baudrate auto-detect has been successfully performed.
10. You may observe the small green LEDs marked RXF and TXF, next to the fiber ports, illuminate when data is received or transmitted.
11. The CAN-Bus Extenders are now operating on the network and they are ready operate in the CAN network.
12. If any of the LED's – marked DGN, NSA and NSB – blink red, this indicates that the internal message buffer on the CANR-DF has been filled before the device could transfer all previously received messages out the other side. Some messages may be lost. Slowing down the scan rate should help eliminate this.

3. General Specifications

Product: WRC-CANR-DF-DN and WRC-CANR-DF-SM, Series 4 CAN-Bus Extender and Fiber Optic Converter

Description: Electrical Extender to extend the cable distances of CAN-based protocol products and convert the copper network to a fiber optic link.

Device Type: Communications Extender

Product Revision: 4.1

DeviceNet Conformance: Designed to conform to the ODVA DeviceNet Specification Volume I, Version 2.0 and Volume II, Version 2.0.

Baud rate: 9.6K, 10K, 20K, 40K, 50K, 100K 125K, 250K, 500K, 800K and 1M baud fixed or auto-detect baud rate on DeviceNet

Address selection: Not applicable

Bus Connection:
Used On Device: Woodhead # 1R5006A17A120, male pins, male threads
CAN-Bus Cable: See accessories list

Fiber Optic Cable: *For WRC-CANR-DF-DN*: 50/125µm, 62.5/125µm, 100/140µm, and 200µm, multi-mode, ST termination
For WRC-CANR-DF-SM: 9/125µm single mode, ST termination

Fiber Cable Length: 2200 meters (max)

Fiber Connection:
Used On Device: ST female
Fiber Cable: ST male

Status Indicators:
MS - Module Status: green/red bi-color LED
NSA - Copper Network A Status: green/red bi-color LED
NSB - Fiber Network B Status: green/red bi-color LED
DGN - Diagnostic Data: green/red bi-color LED
TXF - Fiber Transmit Active: green LED
RXF - Fiber Receive Active: green LED

Voltage Isolation: Provided by fiber cable system

Maximum power:
Voltage: 11 - 25 Vdc
Current: 110 mA @ 11 Vdc - 60 mA @ 25 Vdc
Power: 1.5 W

Mounting: Panel-mount, 4 screws

Size:
Length: 5.11" (130 mm)
Depth: 2.27" (57.7 mm)
Height: 3.70" (94.0 mm)

Operating Temp: 0-70 ºC

Humidity: 0-95% RH, non-condensing

4. Hardware Installation and Configuration

4.1. Overview

A CAN-Bus Extender is a single device connected to two parts of a single CAN-Bus network. The CANR-DF is a NEMA-4X enclosure and is panel mounted.

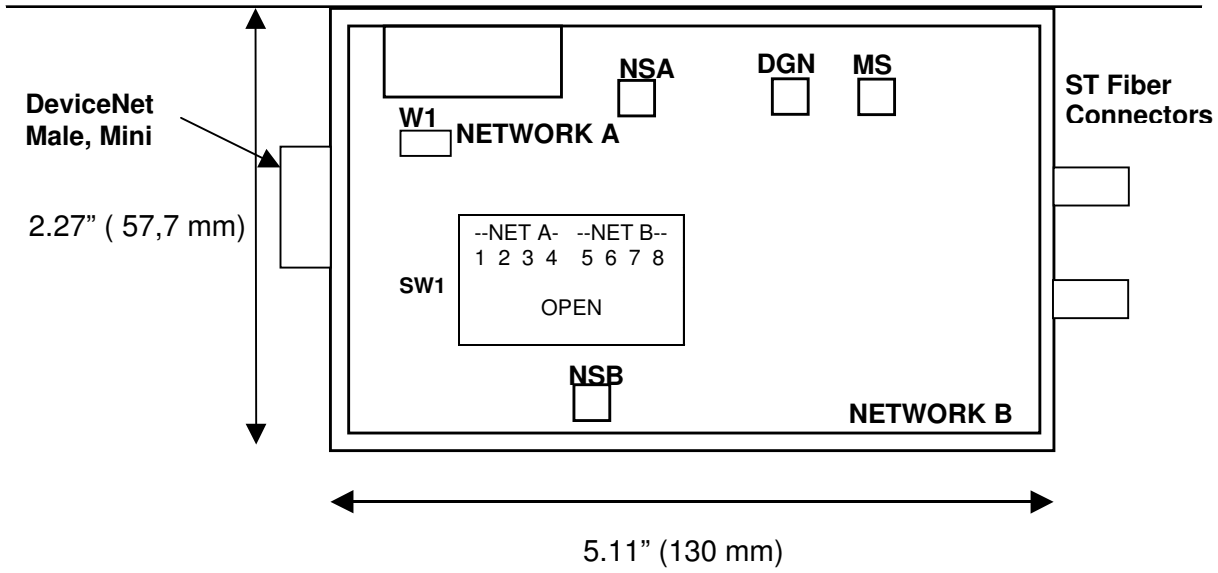


Figure 4-1 WRC-CANR-DF-xx CAN-Bus Extender (2 per)

4.2. LED Operation

A WRC-CANR-DF-DN Multiplexer has six (6) LEDs that provide visual status information to the user about the product and the DeviceNet network. The LED's definitions are summarized as follows and more thoroughly in the tables below in Table 4-1, Table 4-2 and Table 4-4.

- **MS** – Module Status – indicates the general health of the unit and its ability to Store-and-Forward messages.
- **NSA** – Network Status A – indicates the condition of the CAN bus connection of this Local unit.
- **NSB** – Network Status B – indicates the condition of the Remote unit's CAN bus operation on the other end of the fiber cable.
- **DGN** – Diagnostic – indicates status of the fiber-optic link.
- **RXF** – Receive Fiber – green indicates electrical signals being received by the CANR.
- **TXF** – Receive Fiber – green indicates electrical signals being sent by the CANR.

Table 4-1 Module Status LED (labeled MS)

LED State	Module Status	Meaning
OFF	No Power	There is no power through DeviceNet.
Green	Device Operational	WRC-CANR is operating normally.
Flashing Red	Minor Fault	Advanced Memory Technology (AMT) buffers space exceeded.
Red	Unrecoverable Fault	WRC-CANR may be damaged.
Flashing Red/Green	Device Self-Testing	WRC-CANR is in self-test mode.

Table 4-2 Local Device's Network Status LEDs (labeled NSA)

LED State	Module Status	Meaning
OFF	No Power / Not on-line	WRC-CANR has no power or device is not operating.
Flashing Green	Idle	WRC-CANR has not received a valid message for 0.5 sec.
Fast Flashing Green	Autobaud selection	The WRC-CANR is waiting for a valid message to fix the baudrate.
Green	On-line	WRC-CANR is operating normally and receiving messages.
Flashing Red	CAN controller buffer overflow	There is more traffic on the network than the system can handle.
Red	Critical link failure (Bus Off)	WRC-CANR has detected an error that makes it incapable of communicating on the link.

Table 4-3 Remote Device's Network Status LEDs (label NSB)

LED State	Module Status	Meaning
OFF	No Power / Not on-line	WRC-CANR has no power or device is not operating.
Flashing Green	Idle	WRC-CANR has not received a valid message for 0.5 sec.
Fast Flashing Green	Autobaud selection	The WRC-CANR is waiting for a valid message to fix the baudrate.
Green	On-line	WRC-CANR is operating normally and receiving messages.
Flashing Red	CAN controller buffer overflow	There is more traffic on the network than the system can handle.
Red	Critical CAN link failure (Bus Off)	WRC-CANR has detected an error that makes it incapable of communicating on the CAN bus.

Table 4-4 Diagnostic Status LEDs (labeled DNG)

LED State	Module Status	Meaning
OFF	Normal	Normal operation.
Green	Fiber Link OK	Serial link to fiber network operating.
Red	Time-out	Unit has not received a serial message (status or can) from the fiber link.
Flashing Red	Communications error	Internal FIFO stack has overflowed on the fiber link interface.

The Green TXF and RXF LED's are illuminated when data is actively transmitted out to the fiber link.

4.3. DIP Switch Settings

The WRC-CANR-DF has an 8-pole DIP switch.

- Switch positions 1-4 are used to set the baud rate of the CANR on which it is located (the local unit).
- Switch positions 5-8 are used to set the baud rate on the CANR at the other end of the fiber cable (the Remote Device).

The baud rates can be set independently, or one side can take its baud rate from the other side (in the "Remote" setting).

The Autobaud detects from DeviceNet bauds.

For CANopen speeds, select the fix baudrate setting.

When both the CANR units are set to all open switch positions (remote-remote) it scans through DeviceNet baudrates.

Table 4-5 Baud Rate Settings for Switches

Baud rate	Local	Position 1	Position 2	Position 3	Position 4	Meaning
	Remote	Position 5	Position 6	Position 7	Position 8	
125K		CLOSED	CLOSED	CLOSED	CLOSED	Fixed
250K		CLOSED	CLOSED	CLOSED	**OPEN**	Fixed
500K		CLOSED	CLOSED	**OPEN**	CLOSED	Fixed
Autobaud		CLOSED	CLOSED	**OPEN**	**OPEN**	Autobaud for DeviceNet Bauds (125k,250k,500k)
9.6K		CLOSED	**OPEN**	CLOSED	CLOSED	Fixed
10K		CLOSED	**OPEN**	CLOSED	**OPEN**	Fixed
20K		CLOSED	**OPEN**	**OPEN**	CLOSED	Fixed
40K		CLOSED	**OPEN**	**OPEN**	**OPEN**	Fixed
50K		**OPEN**	CLOSED	CLOSED	CLOSED	Fixed
100K		**OPEN**	CLOSED	CLOSED	**OPEN**	Fixed
800K		**OPEN**	CLOSED	**OPEN**	CLOSED	Fixed
1M		**OPEN**	CLOSED	**OPEN**	**OPEN**	Fixed
Remote		**OPEN**	**OPEN**	**OPEN**	**OPEN**	Takes baud rate from the opposite end device. If both sides are remote, Autobaud from either side.
Autobaud		ALL OTHER SWITCH POSITIONS				Autobaud

4.4. Power Requirements

The WRC-CANR-DF CAN-Bus Extender subsystems are powered from the 11-25 Vdc provided by the DeviceNet network. The WRC-CANR consumes 60 mA of current at 25 Vdc, or 1.5 Watts, typical. See Section 3.

4.5. CAN Network Cabling and Configuration

This section provides general guidelines for connecting DeviceNet and SDS systems. You can find detailed specifications in the referenced ODVA DeviceNet and Honeywell SDS specifications.

4.5.1. Cable Lengths

The following provide cable length limits for DeviceNet and SDS systems. These numbers apply independently to each physical section of the CAN (copper) network.

Table 4-6 Network Maximum Lengths - DeviceNet

Baud Rate	Trunk Line Length		Drop Length			
	Maximum Distance		Maximum		Cumulative	
	Meters	Feet	Meters	Feet	Meters	Feet
125 Kbits/s	500 m	1640 ft	6 m	20 ft	156 m	512 ft.
250 Kbits/s	250 m	820 ft	6 m	20 ft	78 m	256 ft.
500 Kbits/s	100 m	328 ft	6 m	20 ft	39 m	128 ft.

DeviceNet has a limit of 64 nodes per network for any baud rate.

Table 4-7 Network Maximum Lengths - SDS

Baud Rate	Trunk Line Length (maximum)		Drop Length (maximum)		No. of Nodes
	Meters	Feet	Meters	Feet	
125 Kbits/s	457.2	1500	3.6	12	64
250 Kbits/s	182.8	600	1.8	6	64
500 Kbits/s	91.4	300	0.9	3	64
1 Mbits/s	22.8	75	0.3	1	32

SDS has a limit of 32 nodes per network for any baud rate.

Note: The CANR-DF CAN bus extender does not enable the user to add more nodes. In addition, it is transparent to the network and does not count as an addressed device.

4.5.2. Network Termination

A CAN-Bus system **must be terminated at each end of a copper trunk line**. The host controller and the **last** node device or WRC CAN-Bus Extender on the network must always be terminated to match impedance and eliminate reflections, even if only two nodes are present. Follow the information below when using a CANR-DF.

The CANR Series 4 has a built-in terminator, which can be selectively included or omitted from the network. To include the on-board terminator (on the DeviceNet side), install jumper W1; or remove the W1 jumper if the on-board terminator in not desired. The CANR is shipped from the factory with the jumper installed. See Figure 4-1 for the location of the jumper.

Trunk line use:

For the purpose of network termination, the CANR-DF is treated as the last node on the copper section of the trunk network (side A) to which it is connected. Therefore, when a CANR-DF is used directly in a trunk line, it must be terminated on side A. The terminating resistor built into the CANR-DF at W1 must be installed, or another terminator at the end of the line could be used in the place of the W1 terminator.

Drop line use:

When CANR-DF is used in a drop line (the Network A side is toward the main trunk), the Network A connection must **not be terminated**. The user must remove the built-in terminator by removing the jumper plug at W1.

Some specifications for the terminating resistor are:

Table 4-8 Terminating Resistors

DeviceNet	SDS
121 ohm 1% metal film 1/4 watt	120 ohm 2% 1/4 watt

Important: Per the DeviceNet and SDS specs -- do not terminate devices on drop lines.

4.5.3. CAN-Bus Connection Wiring

The CANR-DF uses the round, mini-style connector on the copper side A and standard ST connectors on the fiber side B.

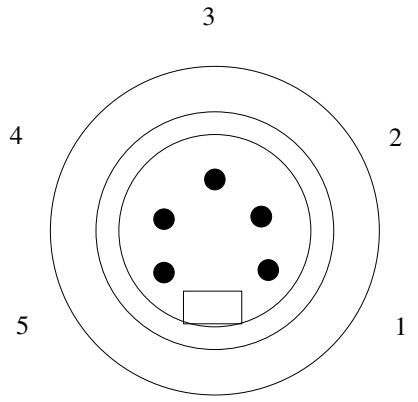


Figure 4-2**DeviceNet** Network Side A cable connector – Male (pins)

Pin #	Function	Wire color
1	Drain	bare
2	V+	red
3	V-	black
4	CAN_H	white
5	CAN_L	blue

Table 4-9 **DeviceNet** cable specifications

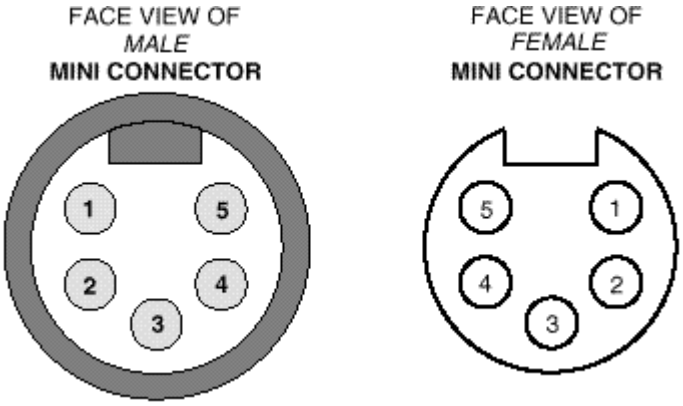


Figure 4-3 **SDS** Mini Connector

Pin #	Function	Wire color
1	Drain	Bare
2	V+	Brown
3	GND	Blue
4	CAN_H	Black
5	CAN_L	White

Table 4-10 SDS cable specifications

4.5.4. Alternate Connector Options

Cable sets may be purchased from an appropriate vendor or custom-made. Turck supplies individual connectors that may be used to build custom DeviceNet or SDS copper cables. Turck part number B 4151-0/16 is a 5-pin, 600V, 9A connector that mates with a number of cables that may be used for the Network A side on the CANR. Contact WRC or your local Turck dealer.

4.6. Fiber Cable

The WRC-CANR-DF-DN employs fiber optic driver and receiver that are capable of operating 50/125µm, 62.5/125µm, 100/140µm, and 200µm multi-mode cable a distance of 2200 meters. They use ST connectors. The Series 4 WRC-CANR-DF-SM can operate with 9/125µm single mode fiber optic cable.

Two fiber cables are required. Each fiber cable is connected between TX of one CANR and RX of the other.

For custom applications using different fiber cable technology, contact WRC.

5. Operation

Each CANR system receives CAN messages and then packs and transmits the messages over the fiber link to the other CANR, which produces the messages onto its CAN bus network. The CANR pair provides electrical isolation between the two CAN sub-networks. It has no CAN address and is logically transparent to the CAN network protocol. The CANR does not interpret nor act on the CAN messages.

The CAN Bus is connected to the A Side of the CANR-DF and receives its power from the Bus.

Whenever a message is transmitted on the Bus to which the CANR-DF pair is connected, one CANR-DF receives the message on the side where it was initiated and performs a store-and-forward of the message to the other side. This action is performed for any valid CAN message independent of who generated it or to whom it is intended.

There a propagation delay of the message through the CANR-DF system, consisting of 2 parts: each CANR introduces approximately a 75 µsec delay, and the transmission time on the fiber link (in both directions) introduces additional delay.

The CANR Series 4 also has the capability for each unit to monitor and report on the status of the other unit in the pair. The NSB LED on one unit reflects the status of the other unit. In this manner you can determine the operating status of both units by observing just one of them.

Also the CANR allows you set up the baud rate for both units from just one. See the section on switch settings, 4.3 above, for more details.

5.1. Application Notes

NOTE: CANR-DF'S ARE ALWAYS USED IN PAIRS!

To help insure ease of installation and reliable operation of your system, the following guidelines should be followed CANR-DF installation in your CAN network.

Proper CAN bus termination is critical to reliable operation of the network. Set the W1 jumpers on the CANR's appropriately.

Other than improper terminators, the most common problem is correct fiber cable connection and termination. Make sure one cable connects TX on one to RX on the other and vice versa. Also confirm that the fiber itself is good quality and the ends are correctly polished and terminated with ST connectors.

Use the on-board LEDs to help determine the health of the fiber cable interconnection.

In Autobaud applications, the baud rate that each device selects will be defined by the first valid message received from either the CAN-Bus or via the fiber connection from the other device.

Although multiple CANR's can be used in series, use only one CANR-DF pair in any network section. That is, only use one CANR-DF pair per trunk line or drop line.

CANR-DF is not a grounded device and the Bus shield is not connected electrically to the device. Therefore, follow appropriate wiring practices to eliminate noise and other problems.

Example of a valid drop line applications are shown in the following figures. See Figure 1-1 for an example trunk line application.

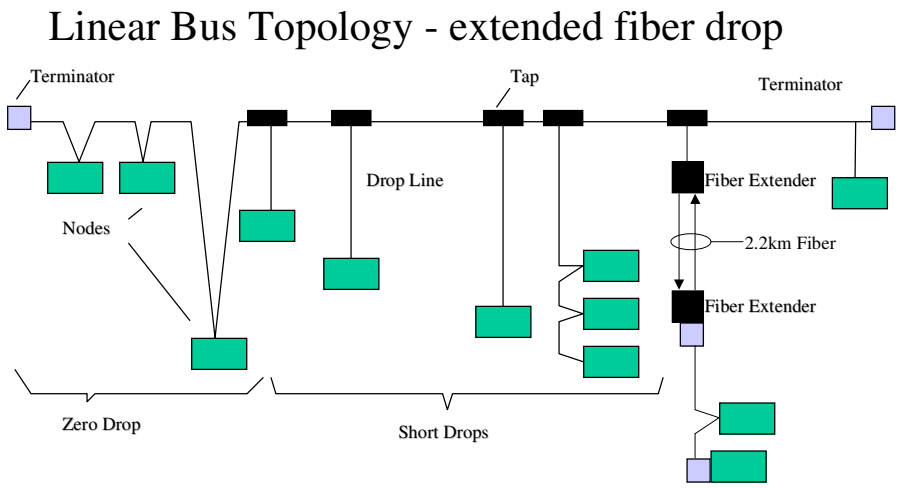


Figure 5-1 CANR-DF on a drop line

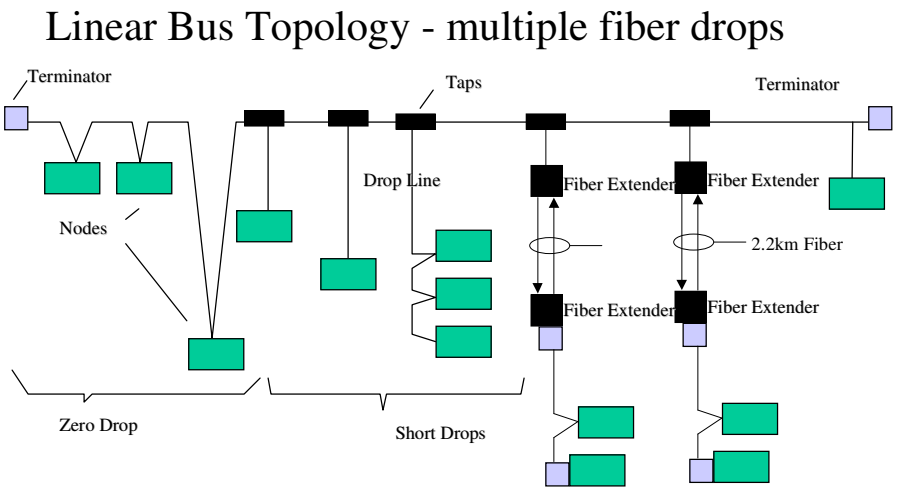


Figure 5-2 CANR-DF on multiple drop lines

6. Accessories and Other WRC Products

The following components can be used with a CANR for replacements or spare parts, or as complementary devices as a part of your DeviceNet system.

	Part	WRC P/N	Equivalent Mfr. Part Number
•	CANX-NEM Cable	n/a	Various manufacturers' Mini-Style Connector Examples: Cable assy. w/ male threads, male pins: Turck RSM 570-*M/630 ("trunk line") Turck RSM 571-*M/630 ("drop line")
•	DIN rail (1 meter)	WRC 50022	Phoenix Contact NS 35/7,5 0801733 (2 m) Allen-Bradley 199-DR1 (1 m)
•	Terminating resistor	RM121DN	121Ω,1%, metal film, axial lead resistor

WRC also provides discrete and analog I/O signal conditioning and multiplexing on DeviceNet, as well as communication gateways. See Table 6-1 on the next page.

Table 6-1 Accessories and Other WRC Products

Part	WRC Part Number
DIN rail	WRC 50022
Terminating resistor, axial lead	RM121DN
Connector, 5-pin mini-round for CANX, CANR	B 4151-0/16 (Turck)
Discrete I/O block – 4 channels	1782-JDB4
Discrete I/O block – 8 channels	1781-JDB8
Analog Input block – 4 channels, 10-bit	1782-JDA4
Analog I/O block – 8 channels, 12-bit	1782-JDA8
DeviceNet to Serial I/O Gateway	1782-JDC
DeviceNet to Serial I/O Gateway, Enhanced	1782-JDCE
DeviceNet-to-Serial I/O Gateway, 4 channels	W5-JDC4
DeviceNet to Modbus Gateway	1782-JDM
Discrete I/O block – 24 channels	WRC1-JDB24
Discrete I/O block – 48 channels	WRC1-JDB48
Discrete I/O, Analog Input block – 24 DIO, 32 AI	WRC1-JDA/24
Discrete I/O, Analog Input block – 48 DIO, 32 AI	WRC1-JDA/48
Analog I/O block - 32 channels	WRC1-JDAIO
Discrete and Analog I/O block – 24 DIO, 32 AIO	WRC1-JDAIO/24
Discrete and Analog I/O block – 48IO, 32 AIO	WRC1-JDAIO/48
Discrete I/O block – 8 DIs, 8 DOs, 4 AIs	W5-JDB16x
DeviceNet, CANopen Extender, DIN mount	WRC-CANX-DIN-DN
SDS Extender, DIN mount	WRC-CANX-DIN-SD
DeviceNet, CANopen Extender, DIN mount	WRC-CANX-DIN-C7
DeviceNet, CANopen Extender, NEMA box	WRC-CANX-NEM-AU
DeviceNet, CANopen Extender, NEMA box	WRC-CANX-NEM-DN
SDS Extender, NEMA box	WRC-CANX-NEM-SD
DeviceNet, CANopen Extender, multimode Fiber Optic, NEMA box	WRC-CANR-DF-DN
DeviceNet, CANopen Extender, singlemode Fiber Optic, NEMA box	WRC-CANR-DF-SM

7. Troubleshooting

This section identifies some of the common problem observed when commissioning or operating a CANR-DF Extender.

Problem:

DeviceNet devices will not communicate on the network
Module Status LED is solid Green
Network Status LEDs are flashing Green at ½ second intervals

Meaning

No transmissions have been received by the CANX for 0.5 seconds.

Possible Solutions:

1. Network cables are broken or disconnected.
2. Network is not properly terminated.
3. All devices have stopped trying to communicate on the network.
4. Power has been lost on the B Side subnetwork.

Problem:

DeviceNet devices will not communicate on the network
Module Status LED is solid Green
Network Status LEDs are flashing Green quickly

Meaning

The CANR is in autobaud and is waiting for a valid message to fix its baud rate.

Possible Solutions:

1. Network cables are broken or disconnected.
2. Network is not properly terminated.
3. All devices have stopped trying to communicate on the network.

Problem:

Some messages are missed on network.
Module Status LED is solid Green
NSA and NSB LEDs are flashing Red

Meaning

Internal CAN buffers are full. Network has more traffic than it can handle.

Possible Solutions:

1. Reduce the scan rate from the Master.
2. Reduce the COS frequency on I/O devices.
3. Decrease the assembly sizes of I/O connections.
4. Recalculate the network traffic and bandwidth without the CANX.

Problem:

Some messages are missed on network.
Module Status LED is flashing Red

Meaning

Internal AMT buffers are full. Network has more traffic than it can handle.

Possible Solutions:

1. Reduce the scan rate from the Master.
2. Reduce the COS frequency on I/O devices.
3. Decrease the assembly sizes of I/O connections.
4. Recalculate the network traffic and bandwidth without the CANX.

Problem:

Device will not communicate on the network

Module Status LED is solid Green
Network Status LED is flashing Green

Possible Solutions:

1. CANR does not see CAN messages on the network.
2. Network does not have a terminating resistor. Add a 121 ohm resistor across the CAN_H and CAN_L signals at the first and last nodes.
3. Network cable is broken or disconnected.
4. Network cable is miswired.

Problem:

Device will not communicate on the network
DGN is solid red or off

Possible Solutions:

1. Fiber Link is broken or not connected
2. Reterminate, Replace or Reconnect the optical fiber.

8. Summary of Changes to Series 4 from Rev 2 and Series 3

To facilitate implementation of the new Series 3 CANR products for customers that are currently users of the CANR Revision 2.xx products, this section summarizes the product changes from Rev 2 to Series 3.

8.1. DIP Switch Baud Rate Settings

Several new options exist for setting the baud rate on the CANR Series 4.

- Like the Series 3, the Series 4 has an 8-position DIP switch block. All 8 switches are defined and used.
- The Series 4 unit is compatible with all CANopen baud rates. These baud rates are fixed by setting the 8 position dip switch to the appropriate configuration.
- See Section 4.3 for details.

8.2. Terminating Resistors

The Series 4 has an on-board terminating resistor on the CAN connection that can be selectively included or excluded from the network circuit. With jumpers W1, the CANR puts a 121-ohm resistor across the CAN_H and CAN_L lines on sub-network side A. See Section 4.5.2 and Table 4-8 for the location of this jumper.

8.3. Operation and Functionality

The Rev 2 version CANR required one Type 1 and one Type 2 unit per connection. The Series 3 and 4 products now make no differentiation – there is only one design. Therefore, you do not need to be concerned with "matching pairs".

Important: **The Series 3 and 4 products are not backwards compatible with the previous versions**.

You cannot implement a network which consists of a Revision 2 product on one end of the fiber and a Series 3 or 4 on the other end. The same is true with networks with a Series 3 on one end and a Series 4 on the other: this will not perform.

8.4. 2.2km Multimode Fiber Link and Diagnostics (WRC-CANR-DF-DN)

The WRC-CANDF-DN Series 3 and 4 have the following fiber serial link improvements:

- Extends your applications for up to 2.2km at any CAN baud rate.
    - This significantly increases opportunities for mining, tank farm, remote out-buildings, and other similar applications.
- Additional diagnostics:

- A "heartbeat" feature has been added to the fiber link on Series 3 and 4 WRC-CANR-DF-DN units. A heartbeat message is generated between the 2 CANR units when no CAN activity is present for approximately 0.5 sec, allowing each unit to confirm the status of the link.
- The NSB LED indicates the health of the fiber connection for both normal traffic and the heartbeat.

8.5. Singlemode Fiber Link and Diagnostics (WRC-CANR-DF-SM)

The WRC-CANR-DF-SM Series 4 can be used with singlemode fiber optic cable and has the following fiber serial link characteristics:

- Extends your applications for up to 12km at any CAN baud rate.
  - This significantly increases opportunities for applications requiring longer range network extension than can be accomplished using single mode fiber.
- Additional diagnostics:
  - As with the mulitmode fiber, a "heartbeat" feature has been added to the fiber link on WRC-CANR-DF-SM Series 4 units. A heartbeat message is generated between the 2 CANR units when no CAN activity is present for approximately 0.5 sec, allowing each unit to confirm the status of the link.
  - The NSB LED indicates the health of the fiber connection for both normal traffic and the heartbeat.

8.6. Enhanced CAN Support

The CANR now supports CAN 2.0 Part B, as well as Part A. It also can operate up to 1M Baud and with CANopen baud rates. (See factory for details.)

8.7. Field Programmable Updates

The CANR Series 3 and 4 units have their programs held in flash memory, which can be updated in the field. Contact the factory for details.

9. Frequently Asked Questions

1. ***On what networks do the WRC CANX and CANR work?***

   The WRC CANX and CANR function with DeviceNet, CANopen, J1939, SDS and other CAN 2.0, Part A and Part B networks. If you don't see your network listed here contact WRC for more information on your network compatibility.

2. ***What's the difference between WRC-CANX-xx and WRC-CANR-xx product families?***

   The primary difference between the two different extender families is the way in which the CAN messages travel. The WRC CANX handles all message transfer internally, while the WRC CANR sends the messages across a fiber link.

   - The WRC-CANX-xx family is a group of single unit CANbus extenders. The unit receives a CAN message on one side and transmits it, without processing or modifying the message, on the other side. It is one unit with two CANbus connectors, one for each "network side."
   - The WRC-CANR-xx is a set of two CANbus extenders. The first unit receives CAN messages and transmits them over a fiber link to the other extender, which receives them, then reproduces the messages on the CANbus without processing or modifying them.

3. ***What are all of these different models? Which WRC CANX or CANR should I choose?***

   We offer many different models of the CANX and CANR in order to meet a wide range of customer needs. The following table provides descriptions of each available CANX and CANR model.

Table 9-1 CANX and CANR Models

Product Type	Model	Description
WRC-CANX	DIN-C7	1 extender with Phoenix connectors. Open frame, DIN rail mounted. Includes protective plexi-glass cover.
	DIN-DN	1 extender with Phoenix connectors. Open frame, DIN rail mounted.
	DIN40K	1 extender with Phoenix connectors. Open frame, DIN rail mounted. Switches preset for 40K baud rate.
	DIN960	1 extender with Phoenix connectors. Open frame, DIN rail mounted. Switches preset for 9.6K baud rate.
	NEM-DN	1 extender with M18 connectors. Comes in protective NEMA 4X box.
	NEM-40K	1 extender with M18 connectors. Comes in protective NEMA 4X box. Switches preset for 40K baud rate.
	DN-HK	1 extender with M18 connectors. Comes in protective NEMA 4X box. DNET power wired from side A to side B-no isolation.
WRC-CANR	DF-DN	Kit includes 2 extenders with M18 and fiber optic connectors. For use with multi-mode fiber optic cable.
	DF-SM	Kit includes 2 extenders with M18 and fiber optic connectors. For use with single-mode fiber optic cable.
	DIN-DF	Kit includes 2 extenders with Phoenix connectors. For use with multi-mode fiber optic cable. Open frame, DIN rail mounted.
	MTGKIT	Mounting kit for DIN rail. For use with CANX or CANR.

4. ***Why does WRC offer CANX & CANR extenders?***

The WRC-CANX/R Extenders are a family of products that extend the communications cable lengths for DeviceNet, J1939, CANopen and other CAN, V2.0, Part A or Part B serial bus systems. These repeaters serve to:

- extend a network beyond its absolute maximum length (e.g., 500 meters for DeviceNet) at the slowest speed
- implement a longer network for a given baud rate (e.g., pushing a 500K baud network beyond 100 m for DeviceNet)
- provide higher speed baud rates for a given network length
- extend the length of the drop cable (e.g., longer drops than 6 m for DeviceNet)
- provide 2500V electrical isolation between 2 sub-nets
- allow the user to employ non-linear network topologies (e.g., star, tree, etc.)

5. ***What types of connections are available for WRC CANX and CANR extenders?***

Please see question 3 if you need to know what connectors come on which WRC CANX or CANR models.

Several of the WRC CANX and CANR extenders come with the 5-pin CANbus connection plug, which accepts cable sizes from 12 AWG - 24 AWG. This is the standard round, mini-style connector (M18) with male pins for copper cable. A standard DeviceNet cord with a female end connects to the CANX or CANR.

- Turck supplies individual connectors ends that can be used to build custom DeviceNet or copper cables (part number B4151-0/16 is a 5 pin, 600V, 9A connector that comes in a male or female variety that will connect to the CANX or CANR). Please refer to www.turck.com to find a distributor near you.

- If you are interested in purchasing pre-fabricated cables with the proper DeviceNet connectors, Brad Harrison is the manufacturer of Woodhead P/N 105002A01F030 (male pins) and Woodhead P/N 105000A01F030 (female pins), which are distributed by Gross Automation at http://www.bradharrisonsales.com/ along with many other 5-pole plug in options. All Woodhead products that are compatible with WRC CANX and CANR are called "mini-change" cordsets.

- Standard Phoenix connectors for use with non-NEMA enclosed units will be supplied with your order if you choose a model using these connectors.

- WRC CANRs use fiber optic receiver/transceivers that are compatible with different fiber grades, so long as they are terminated with ST fiber connectors.

6. ***At what baud rates do the WRC CANX and CANR function?***

The WRC CANX and CANR function at baud rates of 9.6K, 10K, 20K, 40K, 50K, 100K, 125K, 250K, 500K, 800K and 1M fixed and will auto-detect the baud rate on DeviceNet. The CANX and CANR are also capable of handling different baud rates on each side (e.g., a network with a baud rate of 125K plugged into Network side A can communicate with, through the CANX or CANR, a network with a baud rate of 1M on Network side B).

7. ***Does the WRC CANX or CANR require additional termination resistance on the data lines?***

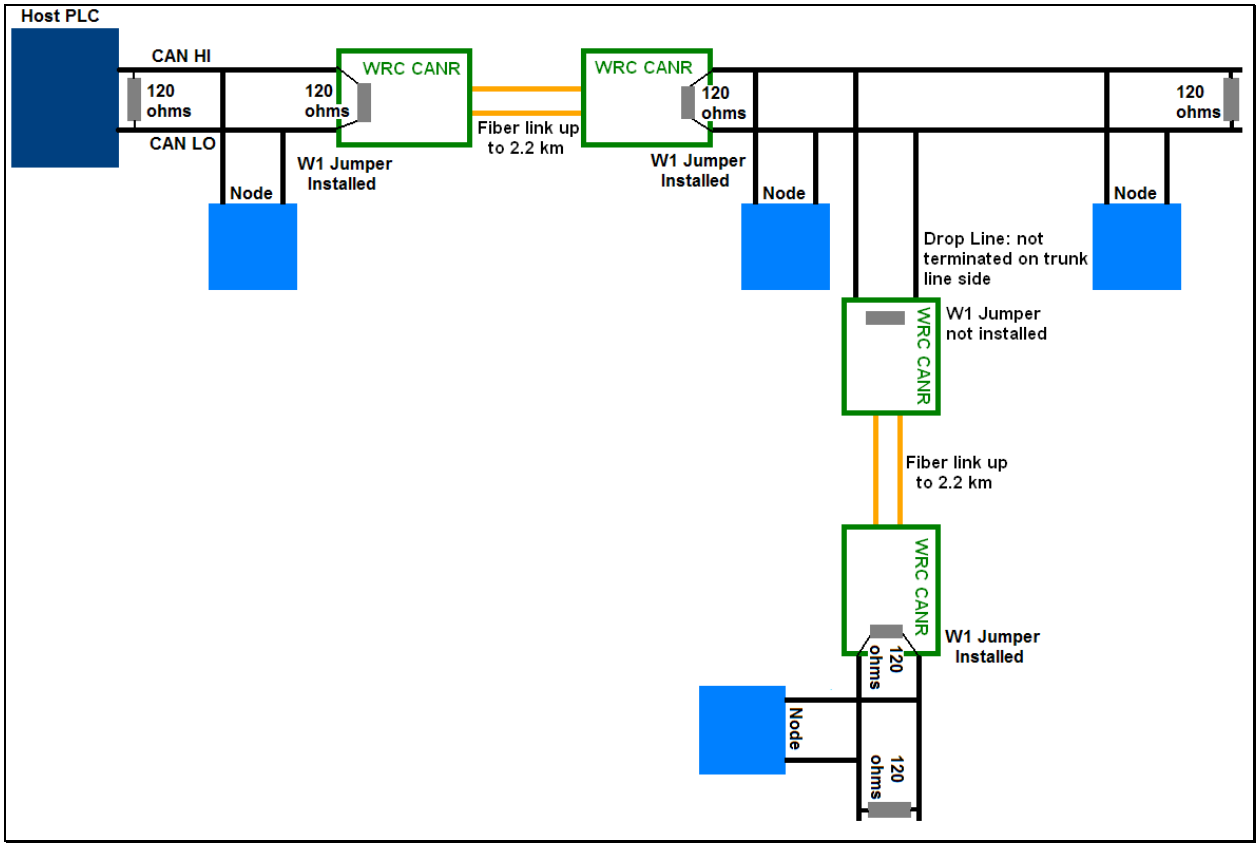
The WRC CANX or CANR functions as the beginning or ending of a new segment of the network. With no power supplied to the network, the resistance across the CAN data lines should be approximately 60 ohms (two 120 ohm resistors in parallel—one on each "end" of the network bus).

- The WRC CANX has two user-selectable 121 ohm resistors on board. Keeping the plastic jumpers, which are installed on all units at the factory, on W1 and W3 will keep these resistors in the circuit, across the CAN data lines. In this case, the user needs only to terminate the other end of each side of the bus with a 120 ohm resistor to insure correct termination on Network side A (on one side of the CANX) and Network side B (on the other side of the CANX). If your network is already terminated at the beginning and end of the bus (net resistance of ~60 ohms), it will be necessary to take the W1 or W3 jumpers off so that the network is not improperly terminated.

- The WRC CANR has one user-selectable 121 ohm resistor on board, which is selected or deselected using the plastic jumper (installed on all units at the factory) on W1. With the jumper on, this resistor remains in the circuit across the CAN data lines. In this case, the user needs only to terminate the other end of the bus with a 120 ohm resistor to insure correct termination. If your network is already terminated at the beginning and end of the bus (net resistance of ~60 ohms), it will be necessary to take the W1 jumper off so that the network is not improperly terminated.

  - It should also be noted that drop lines should not be terminated where they are connected to the main trunk line. For a CANX or CANR in this position the jumper will have to be removed. See the diagrams below for further clarification of proper network setup.

Figure 9-1 Sample WRC CANR Setup



8. ***How do I determine the location in my network at which I might need a WRC CANX or CANR?***

- Drop Line: The WRC CANX or CANR should be used in a drop line when you would like to extend the drop more than 6m.
- Trunk Link: The CANX or CANR should be used in the main trunk line when you desire to extend a network beyond its maximum length (e.g., 500 meters for DeviceNet at 125K baud rate or beyond 100 m for DeviceNet at 500K baud rate)
- Differences in baud rate: The WRC CANX and CANR can pass communications from two different baud rates back and forth with each other (e.g., Network A at 125K and Network B at 500K)
- Isolation: The CANX and CANR can provide 2500V electrical isolation between 2 sub-nets.

9. ***Does the WRC CANX or CANR act as a node on the network?***

No. The WRC CANX and CANR are repeaters, which remain completely invisible to the master device or PLC. The unit does not have a MAC ID. It will only pass messages through (without modifying them) and cannot generate its own messages.

10. ***Does the WRC-CANR-DF-DN work with multi-mode and single-mode graded index optical fiber cable? What sizes/types of fiber cable can it support?***

The WRC-CANR-DF-DN only works with *multi-mode* fiber. The fiber optic transmitters and receivers used on WRC-CANR-DF-DN are directly compatible with the popular "industry-standard" connectors: ST, SMA, FC and SC. The multi-mode fiber sizes supported by these connections are 50/125µm, 62.5/125µm, 100/140µm, and 200µm. The WRC-CANR-DF-SM *only* works with 9/125µm single mode fiber using the ST connector.

11. ***How much power does my WRC CANX or CANR require and what is the best means of supplying it?***

The WRC CANX and CANR should be powered with 11-25Vdc provided by the DeviceNet network, or other DC power supply. The WRC CANX and CANR Series 4 consume approximately 1.5W (60mA at 25Vdc). Power is typically taken from the bus on each side and each side (A and B) requires power. Power applied to the A Side powers the entire unit except the B Side isolated transceiver. If isolation is not required for your application, then the power line may be jumpered from side A to side B. Care must be taken that the power supply is capable of handling the entire load on both sides of the CANX.

12. ***Is there a limit to the number of times a network can be extended using a WRC CANX or CANR?***

There is no technical limit to the number of WRC CANXs or CANRs that can be placed in a network. The number of extenders in a network is generally dictated by the length limitations, due to the operation baud rate, of the network desired. Also, although the CANX and CANR have very small propagation delays, their delay times add up when there are multiple units on one network. For this reason, the master device's EPR time should be adjusted to be greater than the message transmission time (which includes the transmission time on the data lines plus the propagation delay of the CANXs or CANRs) when adding several CANXs or CANRs to your network.

13. ***How do I know how many WRC CANXs or CANRs my application will require?***

While there is no set formula for determining the number of WRC CANXs or CANRs, the length of the network you are trying to create is most likely the dictating factor in the answer to this question. The lengths of drop and trunk lines must follow CANbus guidelines for the selected protocol. A CANX or CANR should be added in the network whenever you desire to extend the length of a drop

or trunk line beyond the normal maximum allowed length. Please refer to the WRC CANX or CANR User's Manual section "Cable Lengths" for more information on the allowed cable distances for each baud rate and network protocol.

14. ***What do the LEDs on the WRC CANX or CANR tell me about how the unit(s) are behaving?***
The Network LEDs on a CANX will be green and blinking slowly if a connection is established, but no messages are being transmitted or received. They will be solid green when messages pass. These same LEDs will be red if there is no connection. The same diagnostics apply for the NSA LED of a CANR, but the NSB LED of a CANR indicates the status of the remote unit and whether the fiber link is hooked up correctly (blinking green with no messages, solid green with messages) or incorrectly (red). The MS LED gives the status of the unit. If it is green the unit is operating normally. If it is blinking red the unit is out of memory, while solid red means the device has failed and may be need to be power cycled or be repaired. Please refer the WRC CANX or CANR User's Manual and see the section on "LED Operation."

15. ***Do WRC CANX and CANR extenders cause signal delays, and what speed of messages can they handle?***

The WRC CANX has a small propagation delay of approximately 810µs, while the CANR has a delay of about 880µs. The Series 4 units have increased buffer sizes from Series 3 and faster message forwarding as well.

16. ***What testing has WRC completed to guarantee the reliable operation of CANX and CANR extenders?***
The WRC production and engineering teams have rigorously tested the CANX and CANR extenders at a variety of strenuous network speeds and environmental conditions with many different network configurations. Although there is no official ODVA test for this type of device, the CANX and CANR have been included in the circuit while running the ODVA conformance testing for a slave device. The slave device passed WRC's in-house protocol conformance test with the CANX or CANR in the circuit, between the master and slave. The CANX and CANR also passed the in-house execution of the OVDA physical layer test. Each CANX or CANR pair is tested for functionality individually before leaving our facility.

17. ***How does the Series 4 WRC CANX or CANR differ from the Series 3 model?***

Single Mode fiber cable is now an option, available with the Series 4 CANR. New switch settings allow selection for CANopen speeds up to 1M baud in addition to the standard DeviceNet baud rates. There are larger internal buffers, which allow the WRC CANX and CANR to store more messages while forwarding them in a first-in-first-out manner, making it even less likely that a message will ever be lost in transmission. There is shorter latency time compared to CANX and CANR series 3. The CANX and CANR also feature improved reverse voltage protection and CAN data lines noise immunity.

18. ***Does the WRC CANX or CANR come with a warranty?***

    Yes, the WRC CANX and CANR, like all WRC products, are covered under a two year factory warranty from the date of invoice that all hardware furnished under order will be free from defects in material, workmanship and design.

19. ***How are field programming updates accomplished?***

    In the event that your WRC CANX or CANR is in need of an update, contact WRC. We will discuss with you the options you have for your network.

If the answer to your question is not found here, or you require further assistance, please contact Western Reserve Controls at:

1485 Exeter Road
Akron, OH 44306
330-733-6662 (phone)
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For product information, e-mail: sales@wrcakron.com
For technical support, e-mail: support@wrcakron.com